Project Report: Oceans and Kuiper Belts in Extrasolar Planetary Systems

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Project Progress

Our project on identifying asteroid belts and comets around other stars has moved forward on two fronts:

1) When a main sequence star evolves into a red giant and its Kuiper Belt objects

(KBOs) reach a temperature of ~170 K, the dust released during the rapid ice sublimation of these cometary bodies may lead to a detectable infrared excess at 25 microns, depending on the mass of the KBOs. Analysis of Infrared Astronomy Satellite (IRAS) data for 66 first−ascent red giants within 150 pc of the Sun provides an upper limit to the mass in KBOs at 45 AU orbital radius that is usually less than ~0.1 M(Earth). With improved infrared data, we may detect systems of KBOs around first−ascent red giants that are analogs to our solar system. (Jura, M. 2004, Astrophysical Journal, 603, 729. "Other Kuiper Belts")

2) The increase with time in the luminosity of a main−sequence star can eventually lead to substantial evaporation of the oceans on an orbiting terrestrial planet. Subsequently, the gas−phase H_2O in the planet's upper atmosphere can be photodissociated by stellar ultraviolet, and the resulting atomic hydrogen then may be lost in a wind. This gaseous envelope may pass in front of the host star and produce transient, detectable ultraviolet absorption in the Lyman lines in systems older than 1 Gyr. (Jura, M. 2004, Astrophysical Journal, 605, L65. "An Observational Signature of Evolved Oceans on Extrasolar Terrestrial Planets.")

Roadmap Objectives

- ***Objective No. 1.1:*** Models of formation and evolution of habitable planets
- ***Objective No. 1.2:*** Indirect and direct astronomical observations of extrasolar habitable planets